

CLAIMS

What is claimed is:

1. A microfluidic device for analyzing a liquid sample, comprising:
a microfluidic channel having a first end and a second end;
a sample inlet fluidly connected to the first end of the microfluidic channel for receiving the liquid sample;
a filter interposed between the sample inlet and the first end of the microfluidic channel, wherein the filter removes selected particles from the liquid sample;
a bellows pump fluidly connected to the second end of the microfluidic channel; and
a liquid barrier interposed between the bellows pump and the second end of the microfluidic channel, wherein the liquid barrier is gas permeable and liquid impermeable.
2. The microfluidic device of claim 1 wherein the bellows pump comprises a vent hole.
3. The microfluidic device of claim 1, further comprising:
a first check valve interposed between the bellows pump and the liquid barrier, wherein the first check valve permits fluid flow towards the bellows pump;
and
a second check valve fluidly connected to the bellows pump, wherein the second check valve permits fluid flow away from the bellows pump.
4. The microfluidic device of claim 1 wherein the filter comprises a membrane.

5. The microfluidic device of claim 1 wherein the microfluidic channel further comprises one or more optical viewing areas.

6. The microfluidic device of claim 1 wherein the selected particles removed from the liquid sample by the filter comprise white blood cells, red blood cells, polymeric beads or bacteria cells.

7. A microfluidic device for analyzing a liquid sample, comprising:
a first microfluidic channel having a first end and a second end;
a sample inlet fluidly connected to the first end of the first microfluidic channel for receiving the liquid sample;
an active valve interposed between the sample inlet and the first end of the first microfluidic channel;
a means for actuating the active valve;
a first bellows pump fluidly connected to the second end of the first microfluidic channel;
a liquid barrier interposed between the first bellows pump and the second end of the first microfluidic channel, wherein the liquid barrier is gas permeable and liquid impermeable;
a second microfluidic channel having a first end and a second end, wherein the first end is fluidly connected to the first microfluidic channel at a location adjacent to the active valve;
a passive valve interposed between the first end of the second microfluidic channel and the first microfluidic channel, wherein the passive valve is open when the fluid pressure in the first microfluidic channel is greater than the fluid pressure in the second microfluidic channel; and
a sample reservoir fluidly connected to the second end of the second microfluidic channel.

8. The microfluidic device of claim 7 wherein the first bellows pump

comprises a vent hole.

9. The microfluidic device of claim 7 wherein the means for actuating the active valve comprise a second bellows pump.

10. The microfluidic device of claim 7 wherein the sample reservoir comprises a vent hole.

11. A microfluidic device for analyzing a liquid sample, comprising:
first and second microfluidic channels, each having a first end and a second end;

a sample inlet fluidly connected to the first end of the first microfluidic channel for receiving the liquid sample;

a first bellows pump fluidly connected to, and interposed between, the second end of the first microfluidic channel and the first end of the second microfluidic channel;

a second bellows pump fluidly connected to the second end of the second microfluidic channel, wherein the second bellows pump has a fluid outlet;

a first check valve interposed between the sample inlet and the first end of the first microfluidic channel, wherein the first check valve permits fluid flow towards the first microfluidic channel;

a second check valve interposed between the second end of the first microfluidic channel and the first bellows pump, wherein the second check valve permits fluid flow towards the first bellows pump;

a third check valve interposed between the first bellows pump and the first end of the second microfluidic channel, wherein the third check valve permits fluid flow towards the second microfluidic channel; and

a fourth check valve interposed between the second end of the second microfluidic channel and the second bellows pump, wherein the fourth check valve permits fluid flow towards the second bellows pump.

12. A microfluidic device for analyzing a liquid sample, comprising:
a first microfluidic channel having a first end and a second end;
a sample inlet fluidly connected to the first end of the first microfluidic channel for receiving the liquid sample;
a first reagent inlet fluidly connected to the first end of the first microfluidic channel for receiving a first reagent;
a bellows pump fluidly connected to the second end of the first microfluidic channel; and
a first liquid barrier interposed between the bellows pump and the second end of the first microfluidic channel, wherein the liquid barrier is gas permeable and liquid impermeable.

13. The microfluidic device of claim 12 wherein the bellows pump comprises a vent hole.

14. The microfluidic device of claim 12, further comprising a check valve fluidly connected to the bellows pump, wherein the check valve permits fluid flow away from the bellows pump.

15. The microfluidic device of claim 12 wherein the first microfluidic channel further comprises one or more optical viewing areas.

16. The microfluidic device of claim 12, further comprising:
a second microfluidic channel having a first end, fluidly connected to the sample inlet, and a second end, fluidly connected to the bellows pump;
a second reagent inlet fluidly connected to the first end of the second microfluidic channel for receiving a second reagent; and
a second liquid barrier interposed between the bellows pump and the second end of the second microfluidic channel, wherein the second liquid barrier is

gas permeable and liquid impermeable.

17. The microfluidic device of claim 16 wherein the second microfluidic channel further comprises one or more optical viewing areas.

18. The microfluidic device of claim 16, further comprising:
a third microfluidic channel having a first end, fluidly connected to the sample inlet, and a second end, fluidly connected to the bellows pump;
a third reagent inlet fluidly connected to the first end of the third microfluidic channel for receiving a third reagent; and
a third liquid barrier interposed between the bellows pump and the second end of the third microfluidic channel, wherein the third liquid barrier is gas permeable and liquid impermeable.

19. The microfluidic device of claim 18, wherein the liquid sample comprises a blood sample, the first reagent comprises antibody-A, the second reagent comprises antibody-B, the third reagent comprises antibody-D.

20. The microfluidic device of claim 18 wherein the third microfluidic channel further comprises one or more optical viewing areas.